

## Letters to the Editor

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### VELOCITY OF ULTRASONIC WAVES IN SOLUTIONS OF ELECTROLYTES — A COMMENT.

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An equation for the velocity  $V$  of ultrasonic wave in a solution of an electrolyte of density  $\rho$  was derived by Satyaprakash and Srivastava (1958), abbreviated as S S hereafter. According to this equation,  $(V\rho)^{\frac{1}{2}}$  of an electrolyte solution should vary linearly with  $\mu$ , the ionic strength of the solution, the gradient of this linear variation remaining the same for different salts of the same valency type. They supported their theory by considering the velocity and density data given by Mohanty and Deo (1955) for zinc and magnesium sulphate solutions.

In their treatment, S S have made use of a simpler expression for the potential,  $\psi_i$ , of an ion which is valid only for very dilute solutions. Using, however, a more elaborate expression,

$$\psi_i = \pm \frac{z_i e}{D} \frac{1}{1 + r\kappa}$$

one can, following the same treatment, arrive at the equation,

$$(V\rho)^{\frac{1}{2}} = \frac{P}{(2I)^{\frac{1}{2}}} + \frac{A}{(2I)^{\frac{1}{2}}} \left( \frac{\mu^{\frac{1}{2}}}{1 + Br\mu^{\frac{1}{2}}} \right)^2$$

where  $r$  is the mean radii of the ions and  $A$  and  $B$  are constants, the rest of the symbols having the same meaning as given by S S. For aqueous solutions at room temperature, the value of  $B$  is  $0.33 \times 10^8$ . Taking the ultrasonic velocity data of sodium chloride solutions given by Weissler and DeGrasso (1951) and

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making use of  $r = 2.2 \text{ \AA.u}$  for this salt, it is found that the graph of  $(V\rho)^{\frac{1}{2}}$  vs  $\left(\frac{\mu^{\frac{1}{2}}}{1+Br\mu^{\frac{1}{2}}}\right)^2$  is a curve even from the lowest concentration and not a straight line as required by the above equation. This prompted the author to verify the original equation of *SS* with regard to other electrolyte solutions.

Ultrasonic velocities for various aqueous solutions of electrolytes determined by Mohanty and Deo, Weissler and DelGrasso, Marks (1960) and the author (1962) are considered and it is found in all these cases that  $(V\rho)^{\frac{1}{2}}$  varies linearly as the ionic strength of the solutions but in no case the corresponding gradient for this linear variation is nearly the same for electrolytes of the same valency type.

Mohanty and Deo have recorded the concentration of zinc sulphate solutions in molal and that of magnesium sulphate in twice molal. This fact was not taken into account by *SS* in using the data to support their theory and hence, by sheer coincidence, they obtained the same gradient for the linear variation of  $(V\rho)^{\frac{1}{2}}$  with the ionic strengths of these two solutions.

It is now a well established fact (Suryanarayana 1962) that  $V\rho$ , the specific acoustic impedance of aqueous solutions of electrolytes, varies linearly as the normality of the solutions with different gradients depending on the ionic radii. This shows that at least for strong electrolytes of uni-univalent type,  $(V\rho)^{\frac{1}{2}}$  cannot at the same time vary linearly as  $\mu$ , much less have a common gradient.

The various factors mentioned above show that the theory proposed by *SS* need a revision and is engaging the attention of the author.

#### REFERENCES

- Marks, G. W., 1960, *J. Acoust. Soc. Amer.* **32**, 327.  
 Mohanty, B. S. and Deo, B. B., 1955 *Ind. J. Phys.* **29**, 578.  
 Satya Prakash and Srivastava, S. S., 1958, *Ind. J. Phys.* **32**, 62.  
 Suryanarayana, M. 1962, *J. Sci. & Ind. Res.* **21B**, 57.  
 Weissler, A. and DelGrasso, V. A., 1951, *J. Acoust Soc. Amer.* **23**, 219.